Knee dislocations: an evaluation of surgical and conservative treatment

Diz çıkıklarında cerrahi ve konservatif tedavinin değerlendirilmesi

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BACKGROUND

We evaluated the results of surgical or non-operative treatment of knee dislocations and the effect of associated soft tissue injuries on the planning of treatment.

METHODS

The study included 12 patients (10 males, 2 females; mean age 34 years; range 17 to 75 years). Knee dislocations were caused by low-energy injuries in five patients, and by high-energy injuries in seven patients. All the knees were dislocated posteriorly. Three dislocations were open. Three patients had popliteal artery injuries and three patients had peroneal nerve injuries. Dislocations affecting the anterior and/or posterior cruciate ligaments were treated surgically (n=6), whereas the medial collateral ligament and lateral ligament injuries were treated non-operatively (n=6). The Lysholm scores and the range of motion of the knees were compared between surgically and conservatively treated groups. The mean follow-up period was 46 months (range 26 to 82 months).

RESULTS

The mean range of motion of the knees (116° versus 72°; p<0.01) and the mean Lysholm scores (84.6 versus 74; p<0.01) differed significantly between patients undergoing surgical and non-operative treatment. Chronic laxity occurred in two knees (one with surgical, one with conservative treatment). Arthrofibrosis developed in four patients (one with surgical, three with conservative treatment). There were no deep infections. Superficial infections occurred in two open dislocations.

CONCLUSION

Knee dislocations should be regarded as significant limb-threatening injuries. Evaluation and immediate treatment of vascular insufficiency is of primary importance. Then, treatment depending on the presence and severity of ligamentous injuries is essential to provide a stable and functional extremity.

Key Words: Anterior cruciate ligament; dislocations; joint instability; knee injuries; knee joint; ligaments, articular; range of motion, articular.

AMAÇ

Diz çıkıklarında uygulanan cerrahi ve konservatif tedavi yöntemlerinin sonuçları ve eşlik eden yumuşak doku yaralanmalarının tedavi şeklini belirlemedeki rolleri değerlendirildi.

GEREÇ VE YÖNTEM

Diz çıkığı tanısı konan 12 hasta (10 erkek, 2 kadın; ort. yaş 34; dağılım 17-75) retrospektif olarak incelendi. Çıkıklar beş olguda düşük enerjili yaralanma, yedi olguda yüksek enerjili yaralanma sonucu meydana gelmişti. Tüm çıkıklar posterior yönde idi. Üç olguda açık çıkık saptandı. Çıkıklara üç olguda popliteal arter yaralanması, üç olguda peroneal sinir yaralanması eşlik etmekteydi. Ön ve/veya arka çapraz bağ yaralanması olan altı olgu cerrahi, medial kollateral ligaman veya lateral ligaman yaralanması olan altı olgu konservatif olarak tedavi edildi. Cerrahi ve cerrahisiz tedavi edilen hasta grupları Lysholm diz skoru ve diz eklemi hareket açıklığı açısından karşılaştırıldı. Ortalama izlem süresi 46 ay (dağılım (26-82 ay) idi.

BULGULAR

Cerrahi uygulanan grupta ortalama Lysholm diz skoru 84.6 iken konservatif tedavi grubunda 74 bulundu (p<0.01). Ortalama diz hareket açıklığı cerrahi grubunda 116 derece, konservatif tedavi grubunda 72 derece saptandı (p<0.01). Biri cerrahi, biri konservatif tedavi gören iki dizde kronik laksisite görüldü. Dört dizde artrofibrozis gelişti (1 cerrahi, 3 konservatif). Derin enfeksiyon hiçbir olguda görülmedi. İki açık çıkıkta yüzeyel enfeksiyon gelişti.

SONUÇ

Diz çıkıkları ekstremiteyi tehdit eden yaralanmalar olarak değerlendirilmelidir. Damar yaralanmasının araştırılması ve acil tedavisi birincil önemdedir. Daha sonra, stabil ve fonksiyonel bir ekstremitenin sağlanması için, eşlik eden bağ yaralanmalarının niteliği göz önüne alınarak tedavi planı oluşturulmalıdır.

Anahtar Sözcükler: Ön çapraz bağ; çıkık; eklem instabilitesi; diz yaralanması; diz eklemi; ligaman, artiküler; hareket açıklığı, artiküler.

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Dislocation of the knee is an uncommon but potentially limb-threatening injury, which should be regarded as an orthopedic emergency, often requiring a multidisciplinary approach.[1] Knee dislocations may occur either alone or in combination with multiple injuries. Some dislocations may go unnoticed during examination and initial treatment of multiple trauma patients, resulting in a spontaneous reduction. The mechanism of injury varies from low-energy sports injuries to high-velocity motor vehicle accidents.[2]

Injuries to neurovascular structures and the presence of compartment syndromes may complicate and alter the planned management of these patients. Damage to the popliteal artery and peroneal nerve is common.[3] Once arterial damage is ruled out, ligament management can be delayed until immediate stabilization and reduction of the knee has been performed and other more pressing fractures and injuries treated.[1] A poor general condition of the patient or associated trauma may make long-term physical therapy problematic or associated life-threatening conditions may make the aim of obtaining adequate knee function an issue of secondary importance.

This retrospective study was designed to evaluate soft tissue injury patterns in knee dislocations, to identify frequency and associations that may aid surgical planning, and to determine both the results after surgical repair or reconstruction versus nonsurgical treatment and the influence of prognostic factors on outcome.

MATERIALS AND METHODS

From 1997 to 2002, 12 patients (10 males, 2 females; mean age 34 years; range 17 to 75 years) received treatment for knee dislocations in Medicine Faculty of Uludağ University. Dislocations included

Table 1. Lysholm knee scale[4]

Limp (5 points)	
None	5
Slight or periodic	3
Severe and constant	0
Support (5 points)	
Full support	5
Cane or crutch	3
Weight-bearing impossible	0
Stair climbing (5 points)	
No problems	5
Slightly impaired	3
One step at a time	2
Unable	0
Squatting (5 points)	
No problem	5
Lightly impaired	3
Not past 90 degrees	2
Unable	0
Walking, running and jumping instability (30 points)	
Never giving way	30
Rarely gives way except for athletic or other severe exertion	25
Gives way frequently during athletic events or severe exertion	20
Occasionally in daily activities	10
Often in daily activities	5
Every step	0
Swelling (10 points)	
None	10
With giving way	7
On severe exertion	5
On ordinary exertion	2
Constant	0
Pain (30 points)	
None	30
Inconstant and slight during severe exertion	25
Marked on giving way	20
Marked during severe exertion	15
Marked on or after walking more than 1/4 miles	10
Marked on or after walking less than 1/4 miles	5
Constant and severe	0
Atrophy of thigh (5 points)	
None	5
1-2 cm	3
> 2 cm	0

even those that had been reduced before initial presentation to our institution.

The localization of associated lesions and existing neurovascular injuries were noted. Knee dislocations were classified according to the mechanism of occurrence, namely, high-energy (motor vehicle accidents, major falls) or low-energy (sports trauma, minor falls) trauma, to the direction of tibial displacement with respect to the femur, and to the patterns of ligament injuries.[2]

Patients were evaluated with respect to physical examination findings, the type of injury as open or closed, the patterns and treatment methods of knee ligament injuries, the choice of conservative or surgical treatment, pre- and post-treatment range of motion (ROM) values, and functional outcomes. The results were evaluated according to the Lysholm knee scale (Table 1).[4]

Open knee dislocations were debrided and irrigated and external fixation was performed to stabilize the relative position of the femur and tibia. Appropriate antibiotic treatment was begun. Patients with tetanus-prone injuries were immunized.

On neurovascular examination, the lesions were defined as major arterial injuries in the absence of a pulse. Patients were taken immediately to the operating room to minimize the ischemia time. Following exploration, the popliteal artery was repaired by saphenous vein graft. Preoperative arteriography was not routinely performed. Fasciotomy of lower leg was performed to prevent reperfusion swelling. Nerve injuries were explored and treated appropriately. The Lysholm scores and the range of motion of the knees were compared between surgically and conservatively treated groups. Statistical analyses were made with the use of the Student's t-test and *p* values of less than 0.01 were accepted as significant. The mean follow-up period was 46 months (range 26 to 82 months).

RESULTS

Dislocations of the knee were caused by low-energy injuries during sports in five patients, and by high-energy injuries (5 motor vehicle accidents, 2 major falls) in seven patients. All the knees were dislocated posteriorly (Fig. 1). They were classified by the pattern of ligament injury according to Schenck et al.[2] Injuries involved the anterior and posterior cruciate ligaments (ACL, PCL) and both the lateral and medial collateral ligaments (KD IV) in four patients; ACL, the medial and lateral collateral ligaments (KD I) in three patients; ACL, PCL, and the lateral collateral ligament (KD III L) in two patients; and ACL, PCL, and the medial collateral ligament (KD III M) in three patients.

Three dislocations were open. There were coexisting fractures in six patients, four of whom had ipsilateral supracondylar femur fractures and tibia fractures. Two of the tibial fractures were open (grade III B). Two patients having vertebra fractures underwent surgical stabilization. The other coexisting fractures involved the calcaneus, talus, patella, and the maxilla-mandible.

Popliteal artery injuries occurred in three patients, including two intimal lesions and one complete rupture of the artery. Two were associated with high-energy open dislocations, and one with a low-energy dislocation due to sports trauma. These patients were treated by saphenous vein grafting and fasciotomy of the lower leg.

There were three peroneal nerve injuries. In one patient, exploration of the nerve was acutely made in the open dislocation and the nerve was found intact. The condition was regarded as neuropraxia and neurolysis was performed. In the other two patients, peroneal nerves were explored at a later time and were found to have sustained axonotmesis, so neurolysis was performed.

Ligament injuries were surgically treated in six patients. Two patients underwent simultaneous ACL and PCL reconstruction under arthroscopy with the use of Achilles tendon allograft (Tutoplast®, Tutogen, USA) at three weeks. In one patient PCL was reconstructed, with ACL being ignored; however, ACL instability became intolerable later and ACL reconstruction was performed. The other three patients underwent ACL reconstruction with the use of patellar tendon allografts, a few months after the initial treatment. The medial collateral ligament and lateral ligament injuries were treated non-operatively with an articulated brace limiting the range of motion between 0 and 100-110 degrees for the first month. Crutches were used for six weeks and aggressive rehabilitation was instituted after three months.

Six patients were treated non-operatively with immediate reduction. Then a splint was used for six weeks, after which the range of motion of the knee increased. Thereafter, a postoperative rehabilitation program was conducted. Muscle strengthening exercises were initiated at the time they became tolerable by the patients.

Chronic laxity occurred in two knees (one with surgical, one with conservative treatment). Arthrofibrosis developed in four patients (one with surgical, three with conservative treatment). These patients had occasional knee pain, for which two patients were given appropriate medications.

There were no deep infections in any of the patients. Superficial infections occurred in two open dislocations, which were cured with antibiotic treatment and local debridement.

The average ROM of the knees was 96 degrees (range 30° to 130°), with 2 degrees (range 0-10°) in extension. The average ROM differed significantly between the two treatment groups, being 116 degrees following surgical treatment, and 72 degrees following conservative treatment ($p<0.01$).

The mean Lysholm score was 80 (range 55 to 93). Patients treated surgically (84.6) and conservatively (74) had significantly different mean Lysholm scores ($p<0.01$).

DISCUSSION

Knee dislocations are often associated with injuries that are limb-threatening such as popliteal artery injury. Serious complications can be prevented through understanding the occurrence of such injuries and employing appropriate treatment methods. Whenever a diagnosis of knee dislocation is made, reduction of the dislocation is the first priority for the benefit of limb salvage.[5]

Vascular injuries have been reported in 30% to 40% of cases.[6,7] There is controversy as to the use and timing of arteriography. Many authors advocated arteriography in all knee dislocations.[6,7] Some studies reported normal vascular findings

Fig. 1. A 45-year-old male patient had a type IV open knee dislocation after a high-velocity trauma. **(a)** Anteroposterior and **(b)** lateral roentgenograms.

following reduction in patients with significant popliteal artery injuries.[2] In contrast, Treiman et al.[8] recommended selective arteriography. Arteriography should never cause a delay in the time for vascular surgery. Emergency exploration may be preferable to delayed arteriography, since, in the presence of vascular injuries, blood flow must be restored within 4-5 hours of ischemia to minimize soft tissue necrosis and to avoid amputation.[6] We employed arteriography only in patients with negative pulses and a positive Doppler examination. Doppler examination has been advocated as a rapid and accurate method of vascular assessment and has been shown to correlate well with the need for arteriography. Shelbourne et al.[9] reported that Doppler examination was a workable alternative to arteriography in assessing low-velocity knee dislocations.

In our study, popliteal artery injuries occurred in three patients. Vascular repair with vein grafts was performed immediately together with fasciotomy of the lower leg, which is required for reperfusion swelling when flow has been disrupted for four hours or longer. In these cases, it is usually preferable to perform fasciotomies prophylactically rather than wait until compartment syndrome develops. No case was missed in our series because of high suspicion and close observation of distal pulse by Doppler examination. Compartment syndrome was found in one patient, it was attributed to increased ischemia time. Amputation rates increase to as high as 86% in knee dislocations associated with vascular injuries when there is a delay of up to eight hours from the time of injury.[2]

Vascular status of the extremity can also be evaluated with the use of the ankle-brachial index (ABI), which is the ratio of the systolic pressure in the ankle to the systolic pressure in the arm, provided that pulses are present. Many authors recommended arteriography when this ratio is less than 0.80.[3] We did not use this technique due to lack of experience.

Neurological damage has been reported in 25% to 40% of cases.[1-3,7] We detected peroneal nerve palsy in three patients. Although some reports indicate that neurolysis does not always result in the return of peroneal nerve function,[10] we found satisfactory functional recovery in these patients following neurolysis.

Although there is no consensus on the exact method of treatment for ligament injuries, early operative stabilization has recently been emphasized.[11] It is important to inform the patient preoperatively regarding the severity of the injury and expected outcomes. Concomitant injuries, age, and preoperative functional level often affect the ultimate result. Non-operative management is comprised of immediate reduction and casting of the knee. This approach was supported by Taylor et al.[12] who reported their experience with a series of knee dislocations without neurovascular injuries. The authors noted better results depending on the severity of injury, rather than on the mode of treatment. The authors recommended that the length of immobilization be 4 to 6 weeks in closed knee dislocations because knees immobilized more than six weeks were found to be very stable, but with an unacceptable degree of stiffness or arthrofibrosis.[12]

Non-operative treatment or sometimes external fixation may be the most appropriate treatment in multi-trauma patients, with a preference of surgically treating ligament injuries. Because knee dislocations occur in a wide spectrum of severity and involvement, the treatment plan depends on the situation of individual patients. With our small patient size in mind, although our results of surgical treatment were better than those of conservative treatment, it is our opinion that early non-operative treatment may be more convenient than surgical treatment. Nevertheless, many authors suggest surgery assuming that acutely operative repair is well suited for young active patients, reserving non-operative treatment for low demand individuals and those who cannot participate in intensive postoperative rehabilitation.[8,13] In a meta-analysis comparing operative and non-operative treatment, Dedmond and Almekinders[14] reported superior results in favor of surgery in terms of range of motion, decreased incidence of knee flexion contracture, and improved Lysholm scores.

Shapiro and Freedman[15] reported arthrofibrosis in four of seven patients who underwent allograft reconstruction for both cruciate ligaments.

Some authors suggested that any combined ACL and PCL injuries be considered a knee dislocation,[13] though vice versa may not be the rule.[2,16,17]

Three cases in our study had knee dislocations with intact PCL.

Knee dislocations have been classified according to the direction of the tibia in relation to the femur.[3] However, this classification system is limited by the fact that spontaneous reduction may occur, and that unless the patient or witnesses accurately describe the mechanism of injury, the type of dislocation remains unknown. Moreover, this classification is not helpful in planning the reconstructive procedure, because the degree of injury to the individual ligaments may vary dramatically.

Knee dislocations are most commonly caused by high-energy trauma, presenting as a wide spectrum of severity and associated injuries. They should be regarded as significant limb-threatening injuries requiring emergency treatment. Evaluation and immediate treatment of vascular insufficiency is of primary importance. Then, treatment depending on the presence and severity of ligamentous injuries is essential to provide a stable and functional extremity.

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